USGS

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Research

Real-Time Water Data via Satellite Telemetry in Florida

By Richard Jay Verdi

The public need for near real-time water data is more important now than ever before. Hydrologic data are a valuable source of information used for various tasks, such as the design of dams, bridges, and culverts and the forecasting of potential floods or droughts. Today, the U.S. Geological Survey (USGS) in Florida posts data from nearly 700 real-time surface-water, ground-water, and water-quality stations across the State on the Internet at URL **http://waterdata.usgs.gov/fl/nwis/rt**. These permanent, real-time stations—many of which are in tidal zones—can be supplemented with temporary stations (not real time) to measure coastal surge during extreme storms (for example, see "Predicting Flooding and Coastal Hazards," this issue, and "Monitoring Hurricane Wilma's Storm Surge," *Sound Waves*, February 2006, URL **http://soundwaves.usgs.gov/2006/02/**).

*Stream gage at the Suwannee River above the Gopher River near Suwannee, Florida (7.6 mi upstream from the mouth of the Suwannee; see map, p. 3). The metal box on top of the wooden platform houses the DCP and battery. Water level is measured by a pressure transducer in a polyvinyl chloride (PVC) pipe—a "stilling well" that isolates the measured water surface from waves and ripples (pipe is hidden by concrete pillar in this view). Data are transmitted to the satellite through a GOES antenna attached to the wooden platform (behind left side of ladder, shaped like a top hat). Photograph by **John Pittman**, November 3, 1999.*

Satellite Telemetry in Florida

In 1972, staff from the USGS office in Miami installed the State's first Data Collection Platform (DCP) in the Everglades, as part of a project with the National Aeronautics and Space Administration (NASA) to test the performance and reliability of a Data Collection System (DCS), using the LANDSAT-1 satellite as the data-relay platform. The DCP collected water-level and precipitation data in the remote field location and transmitted it to the Goddard Space Flight Center in Maryland via LANDSAT-1. After preliminary processing at the flight center, the data were sent in teletype messages two to three times per day to the USGS office, where they were entered into a programmable calculator for processing into the final product. When the final calculations were completed, the data were transferred via teletype to the water-management agencies. Thus, in 1972, getting data from the point of collection to the users took approximately 2 hours, required several steps, and was not automated.

After the initial test project in 1972, additional DCPs were installed each year to meet the needs of water-management agencies and the public, and by 2000, a total of 353 USGS DCPs were transmitting near-real-time water data in the State of Florida. The number of DCPs has increased since then: as of March 21, 2007, a total of 683 USGS DCPs were transmitting in Florida.

Today, DCP data are received via the Geostationary Operational Environmental Satellite (GOES). The GOES satellite appears motionless as it orbits the Earth because it is located in the equatorial plane, approximately 23,000 mi above the Earth's surface. Data from the GOES satellite are received by the DCS (Data Collection System) Automated Processing System (DAPS) in Wallops, Virginia. DAPS is a centralized computer-based processing unit that monitors the GOES satellite for new transmissions. Each DCP has a scheduled transmission interval that

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Submission Guidelines

Deadline: The deadline for news items and publication lists for the August issue of *Sound Waves* is Thursday, June 14.
Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.
Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator© files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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Can't find the answer to your question on the Web? Call 1-888-ASK-USGS

Want to e-mail your question to the USGS? Send it to this address: ask@usgs.gov

(Satellite Telemetry continued from page 1)

ranges from 1 to 4 hours, although during flood events, the DCP can be programmed to transmit as often as the recording interval of the data (for example, every 15 minutes). DAPS distributes the new transmissions to USGS receiving stations through the domestic communications satellite (DOMSAT). Raw transmissions from DOMSAT are translated into a computer-readable format by using a USGS decoding program, and then are uploaded to the USGS National Water Information System Web page (NWISWeb) at URL **http://waterdata.usgs.gov/nwis/rt**. The entire automated process, moving data from the gage to end users, takes only a few minutes.

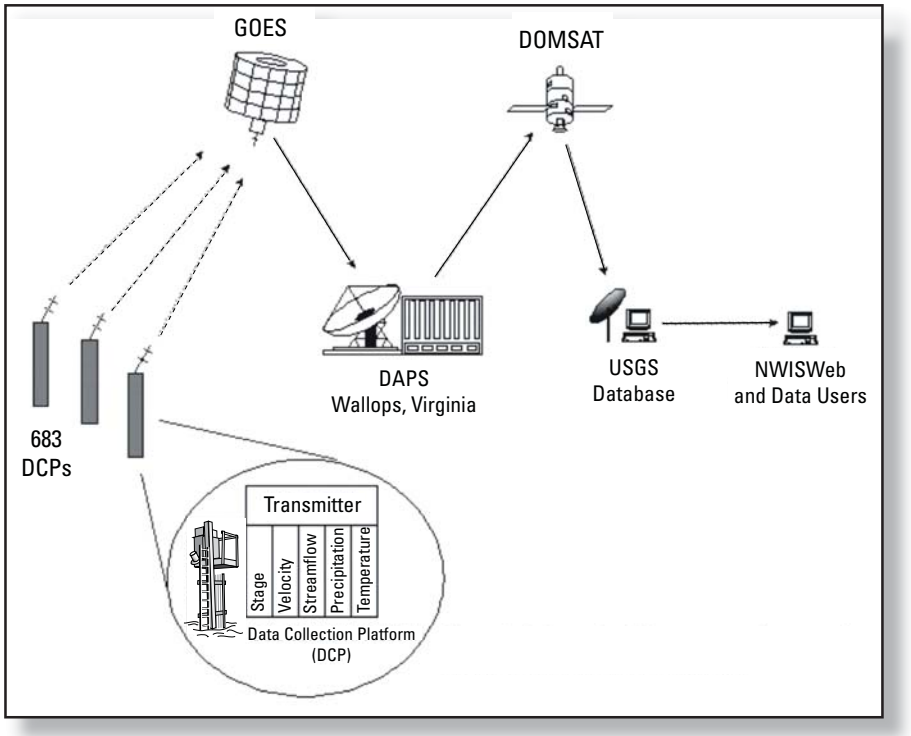
Data Users and Benefits

Hydrologic data can assist various users, such as water-management and emergency-operations agencies, scientists, engineers, transportation users, and recreational water users to (1) evaluate water-use trends and plan for future use, including setting regulatory statutes on water levels, flow, and water-quality parameters; (2) predict and prepare for floods and droughts; (3) regulate reservoir levels and releases from reservoirs; and (4) navigate streams safely. The types of hydrologic data collected and published throughout Florida include stage, elevation, streamflow, water velocity, water temperature, salinity, specific conductance (related to salinity), dissolved oxygen, and weather parameters, such as precipitation, barometric pressure, wind speed and direction, humidity, and temperature.

Timely data delivery is imperative for decision makers to use the data efficiently in making critical decisions, such as forecasting a flood and evacuating and closing roads in low-lying areas. Timely delivery can minimize the loss of life and reduce property damage if sufficient time is available to move property out of the predicted area of flooding.

Another benefit of having the gaging network function in real time is that if a DCP malfunctions (for example, because

(Satellite Telemetry continued on page 3)



*Schematic diagram of the automated process that moves data from gages to users and the USGS National Water Information System Web page (NWISWeb, URL **http://waterdata.usgs.gov/nwis/rt**). The entire process takes only a few minutes.*

(Satellite Telemetry continued from page 2)

of battery failure, instrument failure, or vandalism), a hydrographer is alerted and can make an immediate field trip to the gage location to rectify the problem, thus reducing the loss of data to the end user. Before the advent of DCPs and real-time data, if a data logger failed the failure would not be detected or fixed until the next scheduled field trip, usually every 6 to 8 weeks. Such delays sometimes resulted in loss of data for a significant period. In the infancy of USGS stream-gage data collection, data for missing periods could not always be estimated because there were no nearby gages to use as a comparison; today, streamflow data for nontidal streams can almost always be estimated by using a hydrographic comparison of upstream or downstream gages. In fact, having several gages on one stream helps the National Weather Service, emergency-management officials, and others more accurately determine the timing and magnitude of floods.

Real-Time Status in Florida

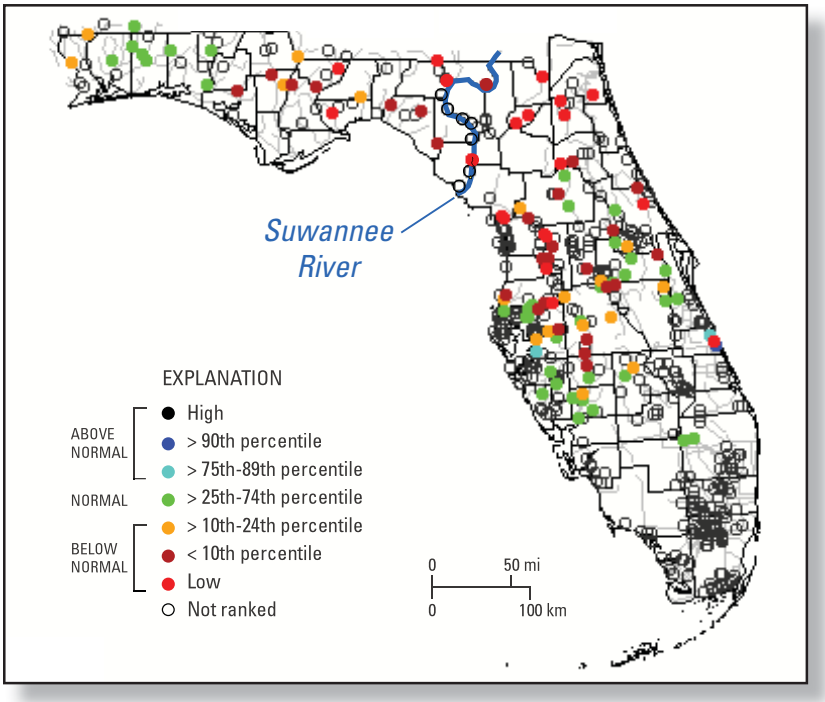
The USGS in Florida is striving to have 100 percent of the continuous-record gaging network available to the public in real time. Overall in Florida, 70 percent of all continuous-record gages are reporting on DCPs in real time, including 86 percent of surface-water, 46 percent of ground-water, and 84 percent of water-quality gages. The distribution of continuous-record stations varies across the State, depending on cooperator and USGS needs versus cost. Funding availability for the gaging program is the most significant factor in determining how quickly the USGS in Florida will achieve its goal of 100 percent of all continuous-record gages being available to the public in real time.

Not only are real-time data available on NWISWeb, but also historical daily values and various statistics for gages throughout Florida can be viewed at and downloaded from URL **http://waterdata.usgs.gov/fl/nwis/nwis**. The availability of all these data is a real asset for society, allowing agencies and the public to make more informed decisions regarding the use of water resources in Florida and the Nation.

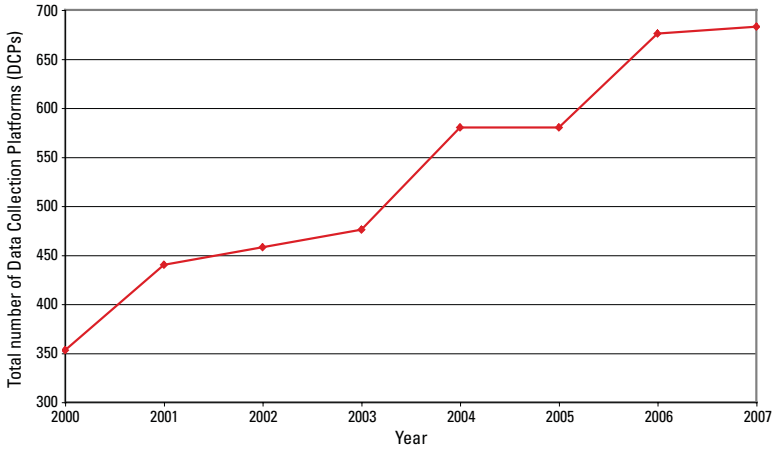
Note: The following publications, available at USGS libraries (URL **http://library.usgs.gov/**), contain additional information about the early use of satellite telemetry for USGS water data:

Shope, W.G., and Paulson, R.W., 1979, U.S. Geological Survey application of satellite telemetry for the support of hydrologic data collection, *in* Deutsch, Morris, Wiesnet, D.R., and Rango, Albert, eds., Satellite hydrology; proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, S.D., June 10-15, 1979: Middleburg, Va., American Water Resources Association, p. 60-64.

Wimberly, E.T., 1975, Satellite relay and processing of hydrologic data in south Florida: U.S. Geological Survey Water-Resources Investigations, no. 12-75, 19 p.



*Map of Florida, showing locations of most of the USGS DCPs transmitting water data in real time (some not shown). Colors indicate streamflow conditions as of 14:06 EDT on April 27, 2007 (from NWISWeb, URL **http://waterdata.usgs.gov/fl/nwis/rt**). (Note: A river discharge at the 90th percentile is equal to or greater than 90 percent of the discharge values recorded on this day of the year during all the years over which measurements have been made; see URL **http://waterdata.usgs.gov/fl/nwis/?percentile_help**).*



Total number of Data Collection Platforms (DCPs) transmitting from Florida from 2000 to 2007.

USGS Current Drifter Ends Decades-Long Journey on Beach in San Pablo Bay

By Helen Gibbons

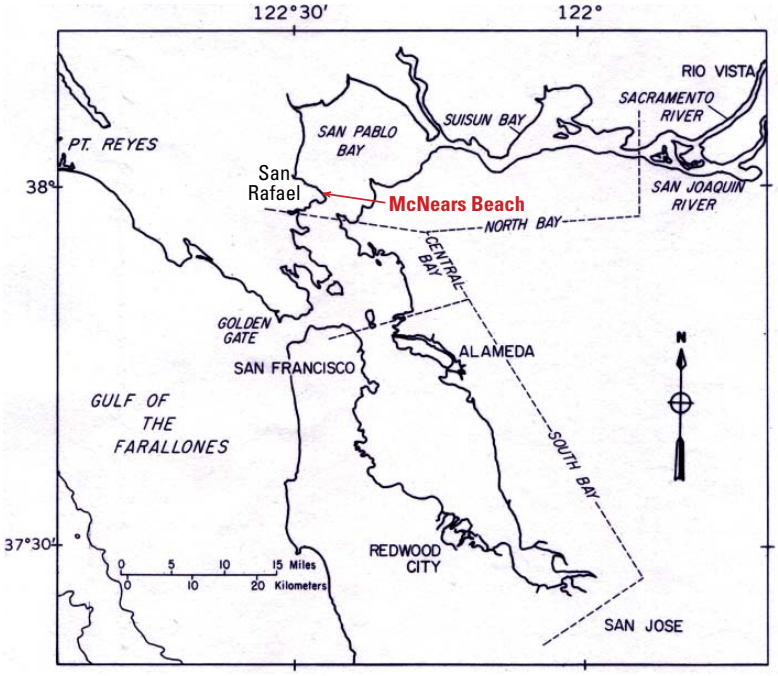
A decades-old U.S. Geological Survey (USGS) current drifter was recently found by a 5-year-old boy on the shore of San Pablo Bay, California, triggering a flurry of e-mails and memories for members of the USGS Western Coastal and Marine Geology Team and the USGS Water Resources Discipline. The drifter—a convex yellow plastic disk attached to a faded red plastic stem with a brass weight near its end—was one of thousands of "near bottom drifters" released in 1970-71 to track currents that carry suspended sediment into and out of San Francisco Bay. This particular drifter was found by **Leaf Allen** on March 11, 2007, at McNears Beach in San Rafael.

USGS hydrologists and geologists undertook the drifter study as part of a larger effort to understand natural processes in the San Francisco Bay system (of which San Pablo Bay is a part), so that scientists could better predict the likely impacts of human activities. A report of the study, "Drift of Surface and Near-Bottom Waters of the San Francisco Bay System, California: March 1970 through April 1971" (USGS Miscellaneous Field Map 333), contains maps showing where the drifters were released and where some of them were found after washing ashore. The authors described the drifter as "a saucer-like plastic disc…that has a serial number, return address, and a statement of reward [50 cents] to be paid with the return of the serial number, and the date and place at which the drifter was found. A brass weight attached to each drifter carries it to the bottom where it is moved with the near-bottom water. Without the weight, the drifter floats and indicates the movement of the surface water."

More than 1,000 near-bottom drifters were released on each of six release dates about two months apart from March 1970 through April 1971. Additionally, approximately 1,000 surface drifters (without the brass weight) were set adrift during the study's last two re-

(Current Drifter continued on page 5)

***Leaf Allen** at McNears Beach on San Pablo Bay, where he discovered a USGS current drifter on March 11, 2007. Photograph by **Amy Allen**.*



*Map of the San Francisco Bay system. Slightly modified from "Drift of Surface and Near-Bottom Waters of the San Francisco Bay System: March 1970 through April 1971," by **T. John Conomos, David S. McCulloch, David H. Peterson,** and **Paul R. Carlson**, U.S. Geological Survey Miscellaneous Field Investigations Map 333, 2 sheets. (URL **http://pubs.er.usgs.gov/usgspubs/mf/mf333**)*

(Current Drifter continued from page 4)

leases. Some of the drifters were released inside San Francisco Bay and some in the adjacent Pacific Ocean. Within 60 days of their release, about 10 to 21 percent of the near-bottom drifters had been recovered and reported, and about 27 to 33 percent of the surface drifters.

The near-bottom drifters released in the Pacific Ocean showed a pronounced eastward drift into San Francisco Bay, which persisted throughout the year of the study. Near-bottom drifters released within the San Francisco Bay system followed one of three dominant flow patterns: (1) a year-round drift westward from Rio Vista to eastern San Pablo Bay; (2) a year-round drift eastward from the Golden Gate, with virtually all drifters turning northward into San Pablo Bay; and (3) a seasonally reversing drift in the south bay, dominantly northward during summer and southward during winter. The surface drifters followed somewhat more complex flow patterns. Excluding several drifters released right at the Golden Gate, no near-bottom drifter released within the bay system was recovered on the ocean beaches, and no surface drifter released seaward of the Golden Gate was recovered within the bay system.

Although the results of the study were published more than 35 years ago, every few years another of the old USGS drifters is recovered and reported. The most recent discovery started a chain of e-mail messages that began with an inquiry from the discoverer's mother and eventually made its way from USGS Science Information and Library Services in Rolla, Missouri, to the USGS office in Menlo Park, California, where many scientists remember the drifter study. Although the data are no longer being compiled, finders still receive the promised reward: USGS scientists recently mailed a box containing USGS pencils, postcards, and publications (and 50 cents) to the boy who found the drifter last March.

Today's drifters are more sophisticated than they were some 30 years ago. For one thing, many electronic components are much smaller, making it fairly easy

(Current Drifter continued on page 6)

Near-bottom drifter found at McNears Beach, San Rafael, California, in March 2007. Photographs by ***Amy Allen****.*

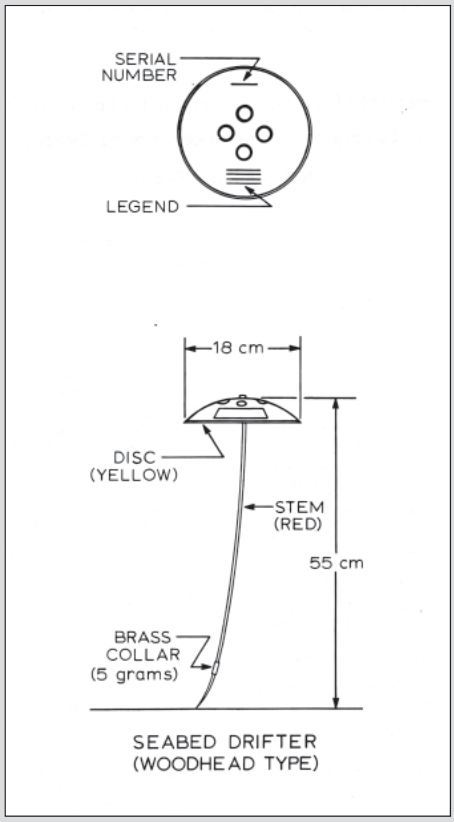
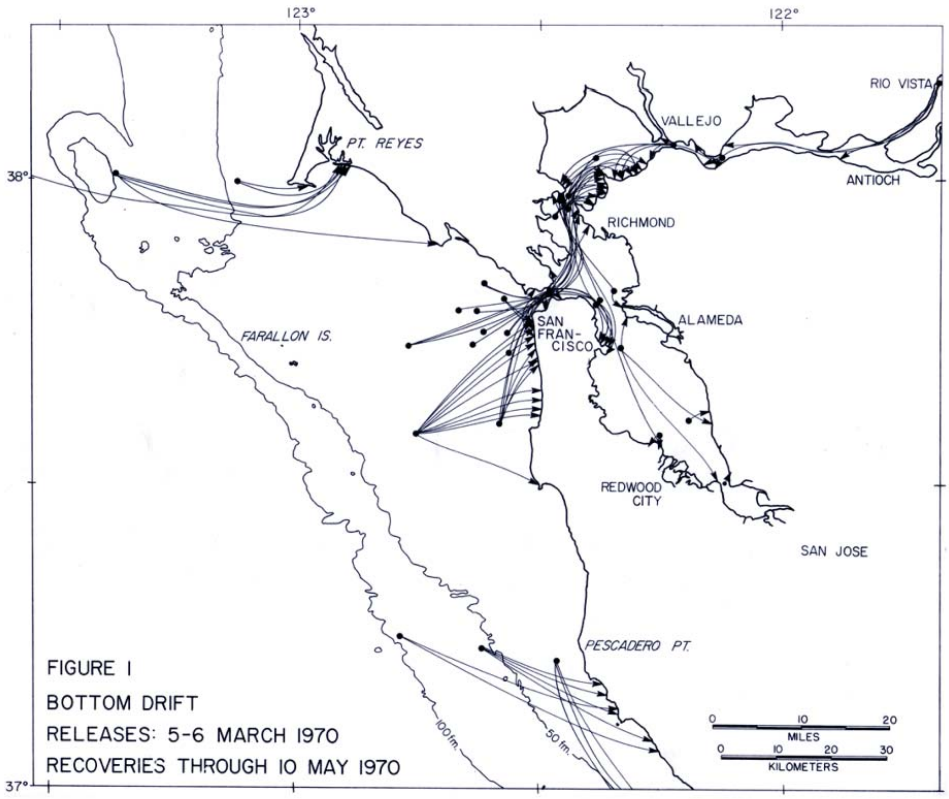


Diagram (top and side views) of near-bottom "seabed" drifter used in USGS study of currents in the San Francisco Bay system and adjacent Pacific Ocean. From "A Preliminary Study of the Effects of Water Circulation in the San Francisco Bay Estuary—Movement of Seabed Drifters in the San Francisco Bay Estuary and the Adjacent Pacific Ocean," by ***T. John Conomos, David H. Peterson, Paul R. Carlson****, and* ***David S. McCulloch****, U.S. Geological Survey Circular 637-B, 8 p. (URL* ***http://pubs.er.usgs.gov/usgspubs/cir/cir637AB****)*

Outreach, continued

(Current Drifter continued from page 5)

to outfit drifters with global-positioning-system (GPS) units that allow scientists to track the drifters throughout their journeys (for example, see "New USGS Drifters Track Hawai'i Coral Larvae" in *Sound Waves*, September 2003, URL **http://soundwaves.usgs.gov/2003/09/fieldwork.html**). But for the simple old USGS drifters that turn up occasionally on San Francisco Bay area beaches, the exact paths they have followed over the past 3 decades remain a mystery.



Map of approximate inferred paths of near-bottom drifters released March 5-6, 1970, and reported through May 10, 1970. From "Drift of Surface and Near-Bottom Waters of the San Francisco Bay System: March 1970 through April 1971" (U.S. Geological Survey Miscellaneous Field Investigations Map 333).

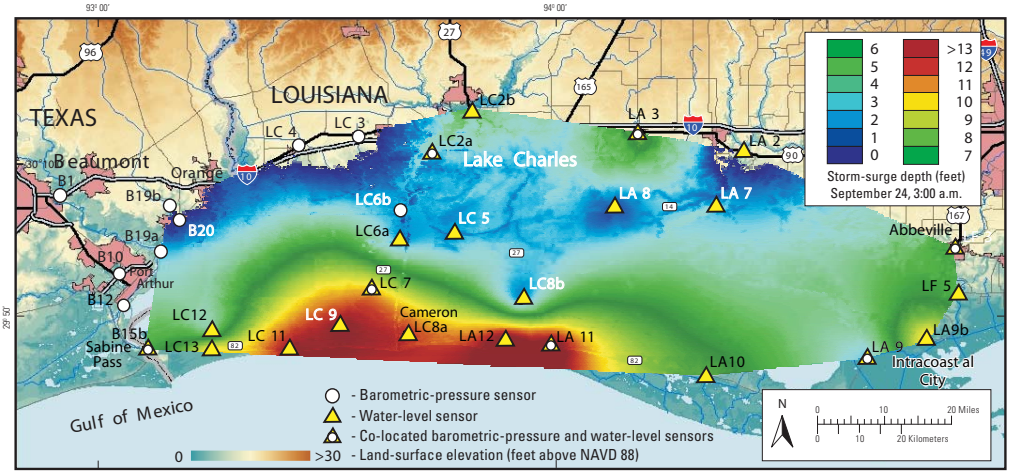
Meetings

Predicting Flooding and Coastal Hazards: USGS Hydrologists and Geologists Team Up at the National Hurricane Conference to Highlight Data Collection

By Laura Fauver

At this year's National Hurricane Conference, held April 2-6 in New Orleans, the U.S. Geological Survey (USGS)'s Water Resources Discipline (WRD) and Coastal and Marine Geology (CMG) Program teamed up to promote USGS research to an audience of coastal planners and emergency managers. **Robert Mason** (WRD, Reston, Virginia) and **Abby Sallenger** (CMG, St. Petersburg, Florida) collaborated on a display for the conference expo, highlighting recent work in coastal-erosion

(Hurricane Conference continued on page 7)



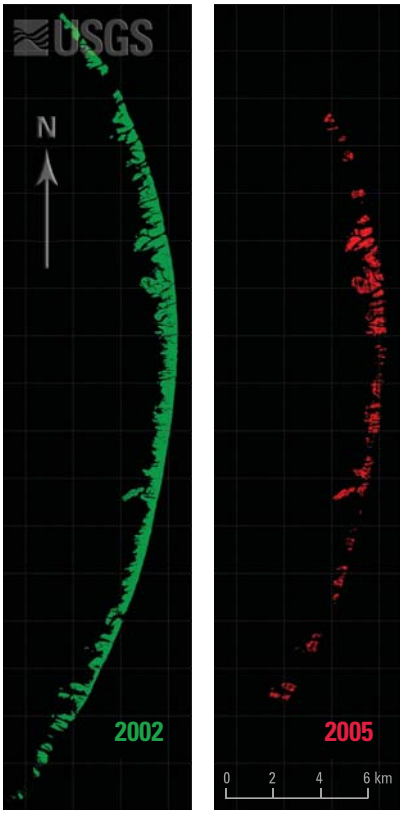
*Inundation map of coastal Louisiana during Hurricane Rita, developed by interpolating water-level data between sensor locations (from USGS Fact Sheet 2006-3136, URL **http://pubs.usgs.gov/fs/2006/3136/**).*

(Hurricane Conference continued from page 6)

and storm-surge research. **Laura Fauver** (CMG, St. Petersburg, Florida) and **Brian McCallum** (WRD, Atlanta, Georgia) staffed the USGS exhibit at the expo, engaging county-level planners in discussions about USGS research and data products that may better facilitate their planning efforts.

Two USGS research programs were highlighted at the expo; one of them was WRD's efforts to monitor storm surge during Hurricane Rita. This work, headed by **Robert Mason** and **Brian McCallum**, used a temporary network of pressure gauges that are deployed in the vicinity of expected landfall as a storm approaches the U.S. coastline. Before Hurricane Rita, USGS personnel deployed 47 sensors, which continuously recorded storm-surge height as coastal Louisiana was inundated. (A similar deployment is described in "Monitoring Hurricane Wilma's Storm Surge," *Sound Waves*, February 2006, at URL **http://soundwaves.usgs.gov/2006/02/**.)

The second program featured at the expo was the coastal lidar (light detection and ranging) monitoring program headed by **Abby Sallenger**. This research focuses on monitoring coastal and barrier-island erosion that occurs during extreme storms and developing relevant predictors for future coastal-erosion events. The Chandeleur Islands in Louisiana were highlighted as an area of extreme coastal change, having lost 85 percent of their surface area during Hurricane Katrina. (See related articles in *Sound Waves* at URLs **http://soundwaves.usgs.gov/2005/10/** and **http://soundwaves.usgs.gov/2005/09/fieldwork2.html**.)

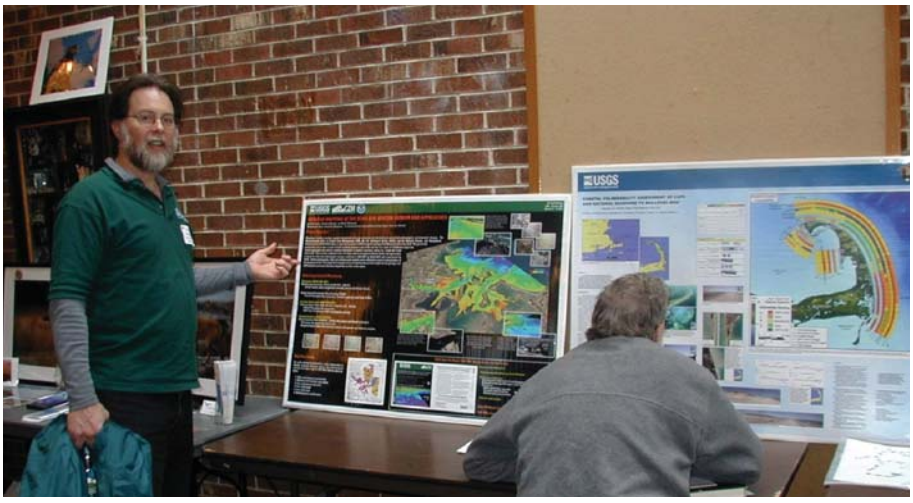


*Geographic extent of the Chandeleur Islands before (left) and after (right) Hurricane Katrina. Images derived from USGS lidar (light detection and ranging) surveys conducted before and after the storm (learn more at URL **http://coastal.er.usgs.gov/hurricanes/**).*

USGS Research Presented at Cape Cod Natural History Conference

By Chris Polloni and Nancy Soderberg

The U.S. Geological Survey (USGS)'s Woods Hole Science Center was well represented at the 12th Annual Cape Cod Natural History Conference, held Saturday, March 17, 2007, at Cape Cod Community College. Sponsored by the Massachusetts Audubon Society (Mass Audubon)'s Wellfleet Bay Wildlife Sanctuary and Cape Cod Five Cents Savings Bank, the conference featured 16 speakers from academic, private research, and public environmental organizations and agencies in the Northeast, describing a range of topics focused on the Cape Cod-Nantucket-Martha's Vineyard region.



***Walter Barnhardt** providing information about his poster. Photograph by **Chris Polloni**.*

Scientists from the Woods Hole Science Center participated in three presentations and provided two table displays, all related to research in and around Cape Cod. **Mary Carman**, Woods Hole Oceanographic Institution, in collaboration with **Page Valentine**, USGS, presented a discussion on "Reducing the Impact of the Invasive Ascidian *Didemnum* sp. [a type of sea squirt] on the Shellfish Industry." **Elizabeth Pendleton**, USGS, talked about "Visualizing Coastal Vulnerability at Cape Cod National Seashore with Google Earth," and **Walter Barnhardt**, USGS, presented "The Seafloor Revealed: Geologic Mapping of the Massachusetts Inner Shelf."

The keynote presentation was given by **Ivan Valiela** of Boston University on "Global and Local Ecological Change on

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(Cape Cod Conference continued from page 7)

Cape Cod as Evidenced from Birds." Using migratory-bird-population data from the USGS Patuxent Wildlife Research Center, **Valiela** demonstrated that migratory-bird populations in the United States were not affected by habitat changes in the Southern Hemisphere, whereas nonmigratory, native bird populations were reduced or displaced by expanding populations of Southern U.S. native species and the increasingly urban environment in the Northeastern United States.

Chris Polloni and **Nancy Soderberg** handled the logistics of USGS participation in the conference and organized and staffed the display tables, where they handed out numerous USGS Fact Sheets and exhibited several posters, including:

"Coastal Vulnerability Assessment of Cape Cod National Seashore to Sea-Level Rise," based on USGS Open-File Report 02-233 (URL **http://pubs.usgs.gov/of/2002/of02-233/**) by **Erika S. Hammar-Klose**, **Elizabeth A. Pendleton**, **E. Robert Thieler**, and **S. Jeffress Williams.**

"Submarine Hydrogeology of a Glaciated Coastline: Cape Cod National Seashore" (abstract available at URL **http://www.neers.org/main/library/abstracts/spring2005.pdf**) by **John F. Bratton**, **VeeAnn Cross**, **David S. Foster**, **John F. Crusius**, and **Jeffrey H. List**.

"Ecologic and Hydrogeologic Importance of Exposed Glaciodeltaic Sediments off Outer Cape Cod, Massachusetts" (abstract available at URL **http://web.mit.edu/seagrant/GIS06/GIS06-AbstractBooklet.pdf**) by **Lawrence J. Poppe**, **Valerie F. Paskevich**, **David S. Foster**, **William W. Danforth**, and **Seth D. Ackerman**.

"Geologic Mapping of the Seafloor: Boston Harbor and Approaches," based on USGS Open-File Report 2006-1008 (URL **http://woodshole.er.usgs.gov/pubs/of2006-1008/**) by **Seth D. Ackerman**, **Bradford Butman**, **Walter A. Barnhardt**, **William W. Danforth**, and **James M. Crocker**.

***Nancy Soderberg** standing by the USGS display table. Photograph by **Chris Polloni**.*

USGS Exhibit at Geological Society of America's Northeastern Section Meeting

By James Degnan

More than 850 people attended the 42nd Annual Meeting of the Northeastern Section of the Geological Society of America (GSA), held March 12-14, 2007, in Durham, New Hampshire. The Northeastern Section extends from the Province of Ontario eastward to the Atlantic Ocean and southward to the District of Columbia (see map at URL **http://www.geosociety.org/sectdiv/**). The U.S. Geological Survey (USGS)'s New Hampshire-Vermont Water Science Center organized a USGS exhibit for the meeting, to which volunteers from USGS science centers across the Northeast contributed time and materials. Sea-floor geology, climate change, bedrock-fracture mapping, and contaminants in unconsolidated sediment were among the wide range of topics covered in posters and reports at the exhibit.

Posters presented at the USGS exhibit included "Geologic Mapping of the Seafloor: Boston Harbor and Approaches" by **Seth Ackerman** and others; "Historical Winter and Spring Trends on New England Lakes and Rivers," by **Glenn Hodgkins**; "Detailed Aquifer Mapping in Upstate New York," by **Richard J Reynolds**; "The Effect of Groundwater on Estimates of Reservoir Firm Yield," by **Stacy Archfield**; "New Hampshire Seacoast Ground-Water Availability Study," by **Tom Mack** and **Marilee Horn**; "Modeling the Probability of Arsenic in New England Drinking Water," by **Laura Hayes** and **Joe Ayotte**; "Fractured Bedrock Well Yield Probabilities in the Pinnardville Quadrangle," by **Rich Moore** and others;

(GSA Northeastern Section continued on page 9)

***Seth Ackerman** (right) explains the role of side-scan sonar in determining the lateral extent and character of marine bottom sediments. Photograph by **James Degnan**.*

(GSA Northeastern Section continued from page 8)

and "Precipitation Runoff Modeling System (PRMS): A Watershed Modeling Study in the Pomperaug River Basin, Connecticut," by **David Bjerklie** and others.

More than 730 USGS reports, Circulars, Fact Sheets, and CDs were distributed during the 4-day meeting. In addition to offering information at the exhibit, numerous USGS scientists also presented results from completed and ongoing studies through presentations and posters at formal sessions during the meeting.

Special thanks are extended to **Carole Johnson** for helping set up the exhibit; **Keith Robinson**, **Tom Mack**, **Phil Harte, Sarah Flanagan**, and **Thor Smith** for helping staff the exhibit; **Rich Moore** for helping pack out; and the New England Disciplines Management Council (NEDMAC) of the USGS for their support of the exhibit.

***Carole Johnson** (center, facing camera) greets attendees during the Sunday evening welcome party, after spending the afternoon helping set up the exhibit. Photograph by **Joe Ayotte**.*

National Parks and Caribbean Marine Reserves Research and Monitoring Workshop

By Caroline Rogers

The National Park Service (NPS) and the U.S. Geological Survey (USGS) have just released a final report on the National Parks and Caribbean Marine Reserves Research and Monitoring Workshop held in St. John, U.S. Virgin Islands, in July 2006. The workshop brought together 30 scientists and managers from the United States (including Puerto Rico and the U.S. Virgin Islands), Mexico, the Bahamas, Belize, St. Lucia, Barbados, Colombia, and the British Virgin Islands. Participants discussed research, monitoring, and management experiences with Marine Protected Areas in Florida and the Caribbean to identify opportunities for future research and monitoring in new marine reserves in Buck Island Reef National Monument, Dry Tortugas National Park, and Virgin Islands Coral Reef National Monument, as well as in Virgin Islands National Park. One of the underlying themes of the workshop was the need to conduct research on the effectiveness of the new reserves in reversing substantial degradation of the coral reefs and changes in associated fish assemblages. Coral reefs in the Virgin Islands lost more than 50 percent of their living coral after a fall 2005 bleaching event and subsequent coral-disease outbreak. Another high priority for research is the degree of connectivity of the NPS reserves with other Marine Protected Areas in the Western Atlantic and Caribbean. The report is available at the USGS Florida Integrated Science Center (FISC) Web site at URL **http://fisc.er.usgs.gov** (scroll down the "Featured Science" column).

*USGS biologists survey coral diseases in St. John, U.S. Virgin Islands. Photograph by **Caroline Rogers**.*

The full citation for the workshop report is:

Rogers, C.S., Davis, G.E., and McCreedy, Cliff, 2007, National Parks and Caribbean Marine Reserves Research and Monitoring Workshop; St. John, U.S. Virgin Islands, July 11-13, 2006: Fort Collins, Colo., National Park Service Natural Resource Technical Report NPS/NRPC/WRD/NRTR-2007/015, 39 p.

High-Resolution Topographic Data and Cross Sections of Recent Coastal Landslide

Panoramic view of the January 1, 2007, Northridge Bluff landslide. Bluff height in this view is about 140 m. View southeastward.

Just a few months after a large landslide tore away part of a coastal bluff that forms the west side of Daly City, California, the U.S. Geological Survey (USGS) published detailed topographic data from the slide area, including map (overhead) views, oblique views, and cross sections. The landslide occurred on January 1, 2007; data collection began on January 9; and the report—"Terrestrial LIDAR Investigation of the December 2003 and January 2007 Activations of the Northridge Bluff Landslide, Daly City, California"—was posted online just 10 weeks later, on March 23. Shortly before publication, the report's first author, **Brian Collins,** was informed by engineers in Daly City's Public Works Department that tension cracks 9 m back from the crest of the current slide had recently appeared, making the report especially timely. The engineers used graphics from the report to show other city personnel and owners of land near the slide what happened, what is going on now with the slide, and what may be expected in the future. They also found the explanations of the slide history and recent events quite helpful and have incorporated the report into the department's archived files.

The data were collected by using the terrestrial lidar (light detection and ranging) technique, also known as "3D laser scanning," which consists of sending and receiving laser pulses to build a set of three-dimensional coordinates of virtually any surface. Data collection occurred at a rate of 8,000 points per second, generating a "point cloud" of three-dimensional coordinates. The point files generated from data collection were transformed into three-dimensional surfaces for cross-section and volumetric analyses. Data collected after the January 2007 slide were compared with similar data collected shortly after a massive slide in the same area in December 2003.

Results show that the 2007 event was a reactivation of the 2003 landslide, about one-third the volume of the 2003 slide, and almost entirely contained within the footprint of the existing 2003 landslide scarp. However, some new earth material was mobilized in the 2007 event, notably in the central head scarp area, where the crest retreated more than 9 m. The slides occurred in an area of steep bluffs extending from sea level to approximately 150 m

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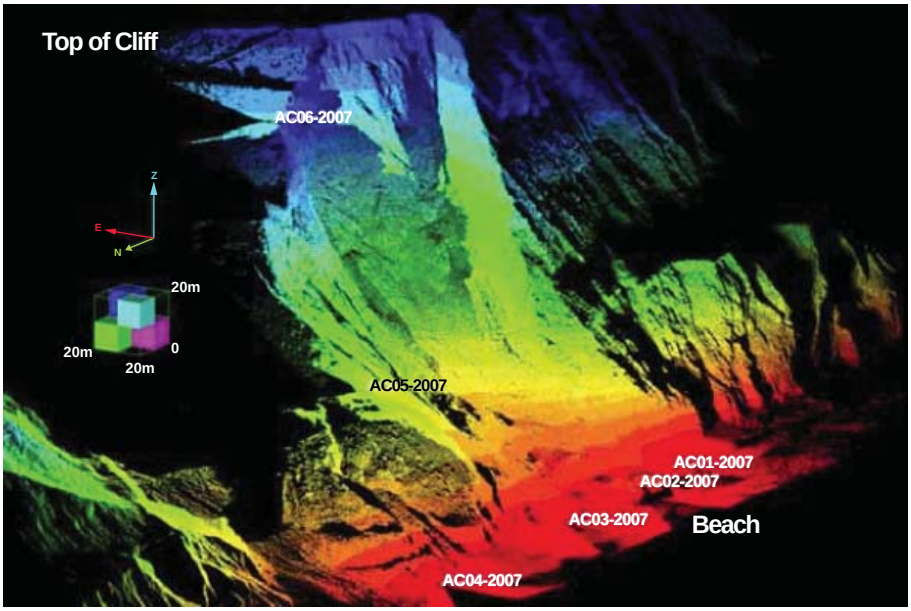

Lidar data collected after the January 2007 landslide. This image is a composite of six lidar scans performed from the numbered locations (AC01-2007 through AC06_2007). Color indicates relative elevation, from red (lowest) to blue (highest). View southeastward.

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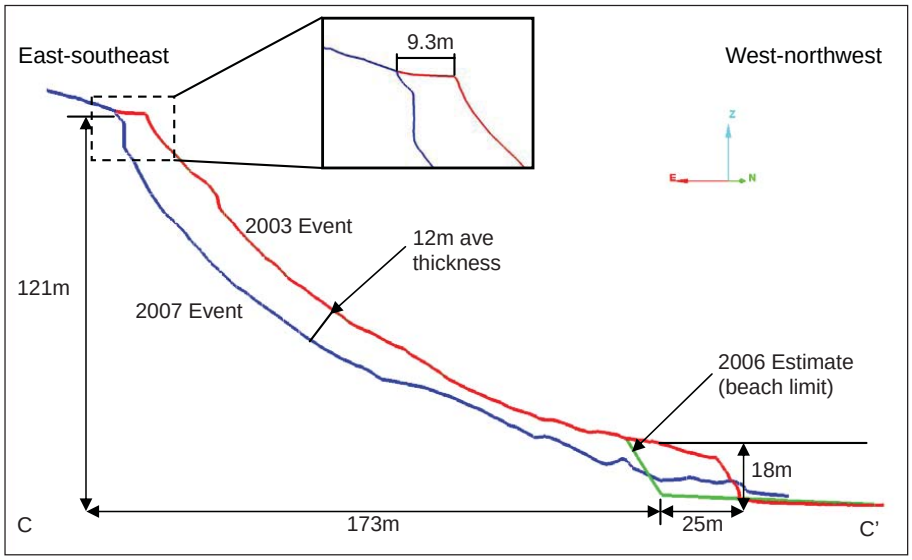
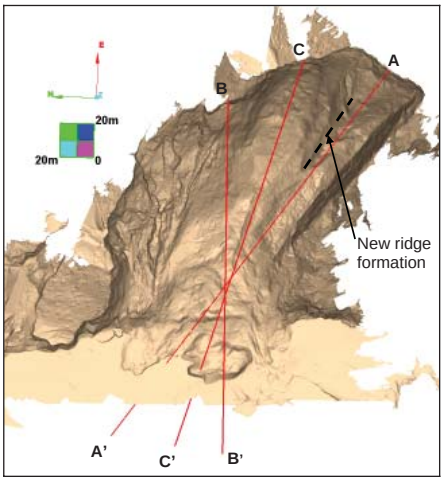
in elevation, composed of weakly consolidated sediment. Residential development, utility lines, and roads occupy the land immediately east of the slide site.

First author **Brian Collins** is a Mendenhall Postdoctoral Research Fellow working with research civil engineer **Rob Kayen** in the USGS Western Coastal and Marine Geology Team. The full reference for the new report is:

Collins, B.D., Kayen, Robert, Reiss, Thomas, and Sitar, Nicholas, 2007, Terrestrial LIDAR investigation of the December 2003 and January 2007 activations of the Northridge Bluff landslide, Daly City, California: U.S. Geological Survey Open-File Report 2007-1079 [URL **http://pubs.usgs.gov/of/2007/1079/**].



Cross section C-C' through the Northridge Bluff landslide, showing land surface shortly after the 2003 event (red) and shortly after the 2007 event (blue); green is assumed geometry of landslide toe before the 2007 event.



Location of cross section; base map is land surface after the 2007 landslide.

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